Results: The ACDS achieved or exceeded all the initial pilot requirements. More that the required number of audits at each level were performed over the initial three years. The audit outcomes will be presented detailing the impact the ACDS audits, and resulting recommendations, have had on radiotherapy practice. The paper will also present on how the staff within the ACDS engaged with the professional clinical workforce and provided a successful and functioning audit service. The paper will attempt to identify these social successes and how these were achieved. This will provide details to assist and advise those seeking to design or modify national or regional auditing programs. Finally the paper reviews the potential future for the ACDS.

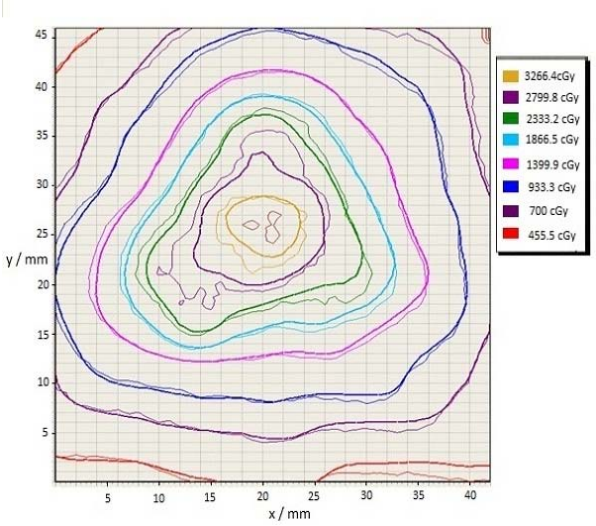
Conclusion: The raw number of audits indicate that the ACDS met the pilot program's initial auditing requirements. Understanding the reasons for the ACDS' success are also important for ensuring an on-going service or informing and assisting others to establish auditing services. Within the ACDS, success has been highly dependent on: attracting quality staff who can respond with agility to changing situations, a high level of communication with the professional community, and a high level of engagement by the community.
The Australian Clinical Dosimetry Service is a joint initiative between the Department of Health and Ageing and the Australian Radiation Protection and Nuclear Safety Agency

EP-1560
Is EBT-XD film suitable for linac and Gamma Knife radiosurgery dosimetry verification and audit?
A. Nisbet[1], A. Dimitriadis[1], A.L. Palmer[2], C.H. Clark[1]
[1]*St. Luke's Cancer Centre Royal Surrey County Hosp, Medical Physics, Guildford, United Kingdom*
[2]*Portsmouth Hospitals NHS Trust, Medical Physics Department, Portsmouth, United Kingdom*

Purpose or Objective: The validation of radiotherapy treatments by dosimetric measurement is essential for the introduction of new techniques, pre-treatment verification and dosimetry audit. Film dosimetry has the advantage of high spatial resolution, low energy dependence and water equivalence. A new film (EBT-XD) has been assessed for its suitability for dosimetry of stereotactic radiosurgery (SRS) applications.

Material and Methods: Calibration curves for red, green and blue channels were created in the range of 0-4000 cGy for EBT-XD and its predecessor EBT3. Ten film pieces were irradiated in a nominal 6MV linac. The film was scanned using an EPSON Expression 11000XL scanner and the analysis was performed in FilmQA Pro software (Ashland ISP Inc, NJ, USA). Film dosimetry uncertainties were assessed for typical SRS fields, including lateral scanner effect at high doses. Both EBT-XD and EBT3 films were used in-phantom for treatment dose verification of typical Linac based and Gamma Knife (GK) stereotactic radiosurgery within the STE2EV anthropomorphic phantom (CIRS, VA, USA). The dosimetry methodology for a forthcoming UK dosimetry audit of SRS treatment was utilised.

Results: EBT-XD film has lower optical density than EBT-3 throughout the dose range tested. EBT-XD was more suitable for high-dose applications because of a lower lateral scanner uncertainty. For the width of the film sizes that will be used in the SRS audit (50 mm) and the typical doses measured, the lateral scanner effect was estimated to be of the range of 0.5% for EBT-XD and 3% for EBT-3. Higher agreement between TPS and film dose distributions was seen for EBT-XD using both single and triple channel dosimetry at 2% (local normalization),1 mm gamma index analysis criteria, with the recommended triple channel used for EBT-XD having a 95.5% passing rate, compared to conventional single channel EBT3 having only 89.1%. Single channel EBT-XD had 89.7% passing rates and triple channel EBT-3 38.9%. An example is shown in figure 1, of EBT-XD showing a 98.3% gamma passing rate for a GK radiosurgery plan at 3% (local), 1.5 mm criteria



Conclusion: We have evaluated the use of a new film, EBT-XD, for SRS dosimetry verification and demonstrated its suitability for a forthcoming audit of radiosurgery services in the UK. EBT-XD is less susceptible to lateral scanner effects and shows better agreement to TPS dose distributions than EBT-3 in linac-based radiosurgery dose verifications. EBT-XD also showed excellent agreement with TPS dose distributions in GK radiosurgery.

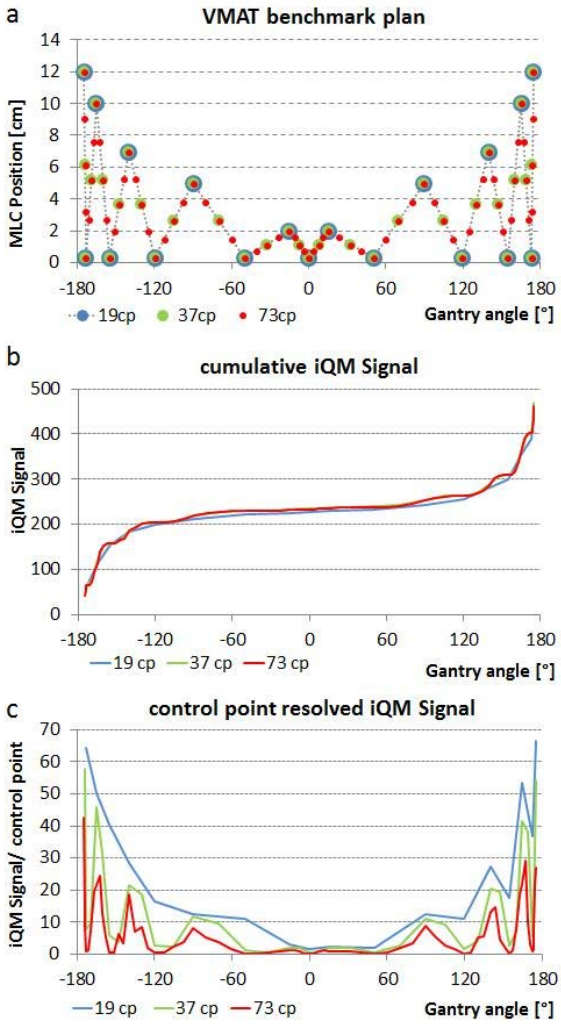
EP-1561
Online control point resolved VMAT QA using the integral quality monitor and log files
M. Pasler[1], M. Obenland[1], J. Christ[1], Y. Jaout[1], H. Wirtz[1], M. Bjoernsgard[2], J. Lutterbach[2], F. Wittkamper[3], D. Georg[4]
[1]*Gemeinschaftspraxis f. Strahlentherapie Singen-Friedrichshafen, Medical Physics, Singen, Germany*
[2]*Gemeinschaftspraxis f. Strahlentherapie Singen-Friedrichshafen, Radiation Oncology, Singen, Germany*
[3]*The Netherlands Cancer Institute, Medical Physics, Amsterdam, The Netherlands*
[4]*Medical University Vienna, Department of Radiotherapy and Christian Doppler Laboratory for Medical Radiation Research for Radiation Oncology, Vienna, Austria*

Purpose or Objective: To systematically assess VMAT delivery accuracy using dynamic benchmark test plans.

Material and Methods: Three VMAT benchmark plans were generated for an Elekta Synergy linac (MLCi2) using iComCAT. These plans consist of square field shapes with varying field size and a full gantry rotation (fig.1a). First, 19 control-points (19cp) were composed to vary dose rate, MLC positions, jaw and gantry speed to push dynamic parameters to their limit. Next the number of control-points was increased (i.e. 37cp and 73cp) by linear interpolation so that MLC, jaw and gantry motion were identical to the 19cp plan, but with tighter regulation of dynamic components. MLC and jaw errors were quantified by analyzing the linac's log files. For dosimetric measurements, a 2D ionchamber array placed in a full scatter phantom (729 & Octavius, PTW) and the integral quality monitor (iQM, iRT) were used. The iQM contains a large area ionchamber and an inclinometer for real-time VMAT verification. Evaluation was performed on the level of cumulated delivery and control-point resolved to investigate the effect of increasing number of control-points.

Results: Slight variations in delivery were observed for the three plans from log-file analysis, overall revealing very accurate linac control in rotational mode. The mean MLC error was almost identical for the three plans (0.2±0.2mm). Relative dosimetric evaluation by means of plan reproducibility resulted in γmean=0.4±0.1 (19cp), γmean=0.2±0.0 (37cp) and γmean=0.1±0.0 (73cp) for the local γ 1%/1mm criterion, respectively. Increased γ-values were found for inter-plan comparison:

γmean(19vs37cp)=0.7±0.1, γmean(19vs73cp)=0.6±0.1 and γmean(37vs73cp)=0.6±0.1. The cumulated iQM signal coincided with 2D ionchamber array measurements and demonstrated accurate reproducibility for all three plans (figure 1b). The control-point resolved analysis (fig.1c) consistently indicated large deviations between 19cp, 37cp and 73cp plans due to an imprecise data sampling synchronization of the preclinical version of the detector. The symmetry of the test plan could not be reflected by the iQM system, especially regarding the 19cp plan.



Conclusion: Increasing the number of control-points changed VMAT delivery accuracy marginally. For clinical treatment plans this effect might not be noticeable. Observation of the cumulative iQM signal coincided well with dosimetric measurements. The VMAT benchmark plan proved to be a prospective tool for visualizing and understanding linac and detector limitations.

EP-1562

VMAT pre-treatment verification using Octavius 4D system: from simple to more complex plans

H. Aslian[2], M. Severgnini[1], F. Cupardo[1], R. Vidimari[1], M. De Denaro[1]

[1]*AOU "Ospedali Riuniti di Trieste", Medical Physics, Trieste, Italy*

[2]*International Center for Theoretical Physics and Trieste University, Medical Physics, Trieste, Italy*

Purpose or Objective: Plan verification in complex treatment delivery techniques such as IMRT and VMAT is imperative. Although some studies have been conducted on pre-treatment VMAT quality assurance using PTW Octavius 4D systems, more works are needed to focus on complex VMAT plans including steep gradient regions. The aim of this study is to evaluate dose delivery of different VMAT plans such as Head and Neck (SIB: Simultaneously Integrated Boost), lung (SBRT: Stereotactic Body Radiation Therapy) and prostate (Hypo-fractionated intensity modulated arc therapy) with the Octavius 4D system.

Material and Methods: Fifteen head and neck, lung and prostate VMAT plans for fifteen patients (5 patients for each case) were created and their respective QA plans were calculated. All plans were optimized and calculated using Monaco (version 5.0) treatment planning system, which is a Monte Carlo-based treatment planning system. The 2D-array seven29, which consists of 729 vented plane-parallel ionization chambers arranged in a 27 x 27 matrix with the spatial resolution of 10mm, embedded in Octavius 4D cylindrical phantom was used to measure the dose distribution and the measurements were done with an Elekta Synergy linear accelerator equipped with an Agility 160 MLC system. In order to reconstruct and analyze the measured 3D dose from each plan, the PTW VeriSoft patient plan verification software was used and a volumetric 3D gamma index analysis for both 3%/3mm and 2%/2mm criteria was performed to compare and evaluate the measured and calculated doses. In addition, in order to improve the spatial resolution in cranial caudal direction due to 1 cm gap across the chambers the second measure was done by shifting the array 5 mm (via couch shift) in caudal direction and merging the matrices with the “merge” function available in PTW VeriSoft.

Results: The mean pass rate of volumetric 3D gamma index for all prostate cases was superior to 97% with 3%/3mm and 92% with 2%/2mm criteria. However, the mean passing rate for lungs was lower than prostate and ranged from 93.7 to 96.3 (3%/3mm) and from 90 to 94.1 (2%/2mm). Expectedly, the mean value of global gamma index for head and neck cases could not be better than 91.5% (ranged from 88.4 to 96.3) and 87.3% (ranged from 82.3 to 89) for the 3%/3mm and 2%/2mm criteria respectively. Also, merged measurements could increase the mean passing rate from 1% up to 3.5% in some complex cases (Fig.1).

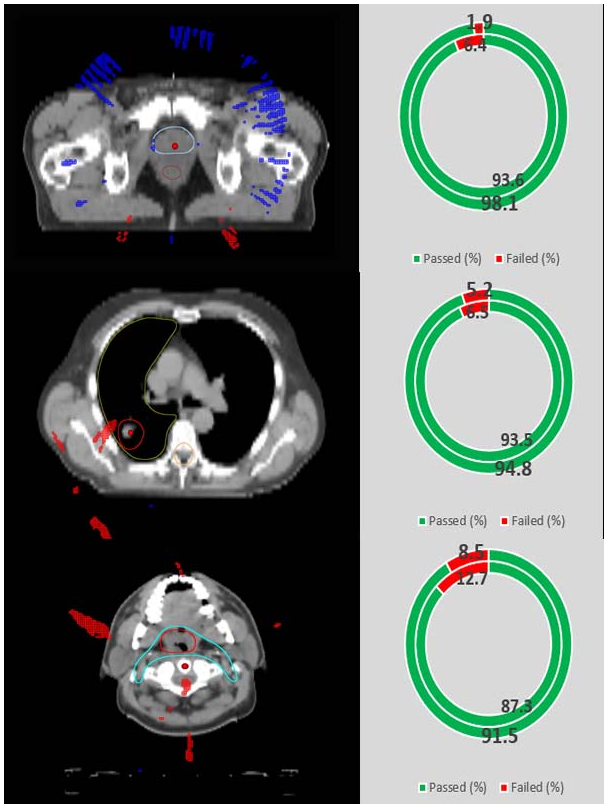


Fig. 1: The images (Left side) represent the failed points of a sample; The images (Right side) depict the average volumetric gamma index for prostates, lungs and HN cases in